Application No. 09/964,463
Reply to Office Action of

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application:

1. (Currently Amended) A semiconductor laser diode comprising:

a ~~GaN~~ contact layer made of GaN;

a first conductive type nitride semiconductor layer formed on said ~~GaN~~ contact layer and made of $Al_xGa_{1-x}N(0.04 \leq x \leq 0.08)$;

a first conductive type clad layer formed on said first conductive type nitride semiconductor layer and made of nitride semiconductor;

a core area formed on said first conductive type clad layer and made of nitride semiconductor, said core area including an active layer to emit light by electric current injection; and

a second conductive type clad layer formed on said core area and made of nitride semiconductor.

2. (Original) A semiconductor laser diode according to claim 1, wherein the thickness of said first conductive type nitride semiconductor layer is from 0.3μm to 1.0μm.

3. (Original) A semiconductor laser diode according to claim 1, wherein said first conductive type clad layer contains $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20, x < y)$.

4. (Original) A semiconductor laser diode according to claim 2, wherein said first conductive type clad layer contains $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20, x < y)$.

CC

5. (Original) A semiconductor laser diode according to claim 1, wherein said first conductive type clad layer has a superlattice structure in which $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20$, $x < y)$ and GaN are alternately laminated.

6. (Original) A semiconductor laser diode according to claim 2, wherein said first conductive type clad layer has a superlattice structure in which $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20$, $x < y)$ and GaN are alternately laminated.

7. (Original) A semiconductor laser diode according to claim 1, wherein said first conductive type clad layer has higher average composition of Al than said first conductive type nitride semiconductor layer.

8. (Original) A semiconductor laser diode according to claim 2, wherein said first conductive type clad layer has higher average composition of Al than said first conductive type nitride semiconductor layer.

9. (Original) A semiconductor laser diode according to claim 1, wherein said first conductive type nitride semiconductor layer has a refractive index lower than the effective refractive index of an oscillating mode in the semiconductor laser diode.

10. (Original) A semiconductor laser diode according to claim 1, wherein said first conductive type nitride semiconductor layer contains $Al_xGa_{1-x}N(0.04 \leq x \leq 0.07)$.

11. (Currently Amended) A semiconductor laser diode according to claim 1, wherein said ~~GaN~~ contact layer is formed on a ~~GaN~~ sapphire substrate with first conductive type.

12. (Currently Amended) A semiconductor laser diode according to claim 1, wherein said ~~GaN~~ contact layer is made of first conductive type GaN and an electrode to inject electric current to said active layer is formed on said ~~GaN~~ contact layer.

13. (Canceled)

14. (Original) A semiconductor laser diode according to claim 1, wherein a second conductive type contact layer made of nitride semiconductor is formed on said second conductive type clad layer, and an electrode to inject electric current to said active layer is formed on said second conductive type contact layer.

15. (Original) A semiconductor laser diode according to claim 1, wherein said active layer has single or multiple quantum well structure having one or more InGaN quantum well layer.

16. (Original) A semiconductor laser diode according to claim 1, wherein said second conductive type clad layer has a superlattice structure in which $Al_zGa_{1-z}N(0 < z \leq 1)$ and GaN are alternately laminated.

17. (Original) A semiconductor laser diode according to claim 1, wherein said first and second conductive type are n-type and p-type respectively.

18. (Original) A semiconductor laser diode comprising:

a sapphire substrate;

an n-type GaN contact layer formed on said sapphire substrate;

an n-type nitride semiconductor layer formed on said n-type GaN contact layer and made of $Al_xGa_{1-x}N(0.04 \leq x \leq 0.08)$;

an n-type superlattice clad layer formed on said n-type nitride semiconductor layer and having a superlattice structure in which $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20, x < y)$ and GaN are alternately laminated;

a core area formed on said n-type superlattice clad layer and made of nitride semiconductor, said core area including an active layer having a multiple quantum well structure with multiple InGaN quantum well layers, said active layer emitting light by electric current injection;

a p-type superlattice clad layer formed on said core area and having a superlattice structure in which $Al_zGa_{1-z}N(0 < z \leq 1)$ and GaN are alternately laminated;

a p-type GaN contact layer formed on said p-type superlattice clad layer made of a p-type GaN;

a p-type electrode formed on said p-type GaN contact layer injecting electric current into said active layer; and

an n-type electrode formed on said n-type GaN contact layer injecting electric current into said active layer.

19. (Original) A semiconductor laser diode according to claim 18, wherein the thickness of said n-type nitride semiconductor layer is from 0.3μm to 1.0μm.

20. (Original) A semiconductor laser diode according to claim 18, wherein said n-type nitride semiconductor layer has a refractive index lower than the effective refractive index of an oscillating mode in the semiconductor laser diode.

COPY

21. (Currently Amended) A semiconductor laser diode comprising:

an n-type GaN substrate;

an n-type GaN ~~contact~~ layer formed on one ~~side~~ surface of said GaN substrate;

an n-type nitride semiconductor layer formed on said n-type GaN ~~contact~~ layer and made of $Al_xGa_{1-x}N(0.04 \leq x \leq 0.08)$;

an n-type superlattice clad layer formed on said n-type nitride semiconductor layer and having a superlattice structure in which $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20, x < y)$ and GaN are alternately laminated;

a core area formed on said n-type superlattice clad layer and made of nitride semiconductor, said core area including an active layer having a multiple quantum well structure with multiple InGaN quantum well layers, said active layer emitting light by electric current injection;

a p-type superlattice clad layer formed on said core area and having a superlattice structure in which $Al_zGa_{1-z}N(0 < z \leq 1)$ and GaN are alternately laminated;

a p-type GaN ~~contact~~ layer formed on said p-type superlattice clad layer made of a p-type GaN;

a p-type electrode formed on said p-type GaN ~~contact~~ layer injecting electric current into said active layer; and

an n-type electrode formed on the other surface of said n-type GaN substrate in order to inject electric current into said active layer.

22. (Original) A semiconductor laser diode according to claim 21, wherein the thickness of said n-type nitride semiconductor layer is from 0.3μm to 1.0μm.

COPY

23. (Original) A semiconductor laser diode according to claim 21, wherein said n-type nitride semiconductor layer has a refractive index lower than the effective refractive index of an oscillating mode in the semiconductor laser diode.

24. (New) A semiconductor laser diode, comprising:

a first conductive type GaN substrate;

a GaN layer formed on one surface of said GaN substrate;

a first conductive type nitride semiconductor layer formed on said GaN layer and made of $Al_xGa_{1-x}N(0.04 \leq x \leq 0.08)$;

a first conductive type clad layer formed on said first conductive type nitride semiconductor layer and made of nitride semiconductor;

a core area formed on said first conductive type clad layer and made of nitride semiconductor, said core area including an active layer to emit light by electric current injection;

a second conductive type clad layer formed on said core area and made of nitride semiconductor;

a second conductive type GaN layer formed on said second conductive type clad layer;

a second conductive type electrode formed on said second conductive type GaN layer injecting electric current into said active layer; and

a first conductive type electrode formed on the other surface of said GaN substrate in order to inject electric current into said active layer.

25. (New) A semiconductor laser diode according to claim 24, wherein the thickness of said first conductive type nitride semiconductor layer is from 0.3 μm to 1.0 μm.

COP

26. (New) A semiconductor laser diode according to claim 24, wherein said first conductive type clad layer contains $Al_yGa_{1-y}N(0.05 \leq y \leq 0.02, x < y)$.

27. (New) A semiconductor laser diode according to claim 25, wherein said first conductive type clad layer contains $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20, x < y)$.

28. (New) A semiconductor laser diode according to claim 24, wherein said first and second conductive type are n-type and p-type respectively.

29. (New) A semiconductor laser diode according to claim 24, wherein said first conductive type clad layer has a superlattice structure in which $Al_yGa_{1-y}N(0.05 \leq y \leq 0.20, x < y)$ and GaN are alternately laminated.

30. (New) A semiconductor laser diode according to claim 24, wherein said second conductive type clad layer has a superlattice structure in which $Al_zGa_{1-z}N(0<z \leq 1)$ and GaN are alternately laminated.

31. (New) A semiconductor laser diode according to claim 24, wherein said active layer has single or multiple quantum well structure having one or more InGaN quantum well layers.

Application No. 09/964,465
Reply to Office Action of

BASIS FOR THE AMENDMENT

Claim 13 has been canceled.

Claims 1, 11, 12 and 21 have been amended as supported by Claim 13 and Claims 1, 11, 12 and 21 as originally filed.

New Claims 24-31 have been added as supported by the specification.

No new matter is believed to have been added by entry of this amendment. Entry and favorable reconsideration are respectfully requested.

Upon entry of this amendment Claims 1-31 will now be active in this application.